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Population Dynamics and Africa's Poise for Post-COVID-19 Growth: Panel Data Analysis

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Abstract: The outbreak of COVID-19 has led to an unprecedented impact on the health, population growth, and economic development of countries globally. The government in most countries came up with measures to curtail the spread of this deadly virus not minding its impacts on their economic growth and population growth. This study examined the relationship between Population Dynamics (PD) and Economic Growth (EG) in twenty-five selected African countries using panel data spanning from 1993 to 2020. Levin, Lin, and Chu test and Lm, Pesaran, and Shin W-stat were used to determine the stationarity conditions of the variables. Also, the pooled mean autoregressive distributed lag model was used to determine the short-run and long-run relationship existing among the variables while the Granger causality test was adopted to determine the direction of the relationship between the dependent and independent variables. The outcome of research findings showed that Levin, Lin, and Chu test and Lm, Pesaran, and Shin W-stat test reveal that the variables were stationery at different orders and the pooled mean autoregressive distributed lag model analysis reveals there are short run and long-run relationships between economic EG and PD. The Granger causality analysis reveals the bidirectional causality between EG and PD. It has shown that PD has a significant impact on EG with the birth rate having a long-run relationship with GDP per Capita which implies that when the economy is booming or viable, there is every tendency that the population will increase through birth rate in a long run in these developing African countries.

Keywords: Economic Growth, Population Dynamics, African Countries, Panel Data, Granger Causality

1. Introduction

On January 30, the Coronavirus disease (COVID-19) was publicly declared by the International Health Regulations Emergency Committee of the World Health Organization (WHO) as a public health emergency that requires internationally grave concern. In other words, COVID-19 pandemic remains a severe public health emergency that poses huge challenges to global socioeconomic transformation. This virus causes common cold which could result in increased deaths. Its symptoms comprise cough, fever, breath shortness [1]. It continues to spread globally with over 41,398,528 cases worldwide, 1,439,587 deaths and estimated 2.5 mean infection rate as of November 27, 2020 [2]. Most of the deaths caused by COVID-19 happened among the aged ones and those that had with pre-existing chronic health conditions.

Africa continent has recorded very few numbers of cases and casualties for COVID-19 compared to other continents of the world but the impending effects this disease will have on the population and socio-economic growth of these countries in terms of trade and investment from investors across the world and a slump in demand due to internal lockdowns are looming and cannot be quantified yet. The idea of limited resources has long time been a subject of discussion among decision makers like demographers, statisticians, economists, and policy makers. The ever-increasing population in developing African nations in this century brought about the argument on whether their economies would be able to sustain the ever-expanding population in their countries as changes over time do have significant effects on any nation's economic performance. The decrease in fertility rates in some developed and industrialized countries has led to shortage of labor hours or workers which resulted in the countries allowing migrants from other countries to come and work in their countries. On the other hand, the rapidly increasing population in some African countries has been a potential obstacle to their socio-economic development, example is a case study of Xenophobic in South African where other African migrants in the country were job snatchers, economy destroyers due to the inability of the country's citizen to be gainfully engaged with jobs. Also, citizens in countries like Nigeria believed that the inability of the government to annex the potential of population growth (PG) is the major problem the country is facing and not the growth itself as a country where majority of her population are teeming youths with little or no jobs to absorb or gainfully engaged them will contribute little or nothing to the economy [3, 4]. Thus, Africa's population dynamics and its poise for post-COVID-19 growth requires sustainable development programs which enables equitable participation in economic opportunities, socioenvironmental protection, human capital development, food security and property security for every individual in a society. It is also the sustained extensive distribution of the benefits and proceeds from economic growth across sectors in per capita terms [4, 5].

2. Literature Review

2.1. Theoretical Review

Based on Malthusian theory that a nation which does not have control over her population growth may likely experience a discouraging or unsuitable economic growth because of scarce and unlimited resources [6]. Despite other continents of the world recording high number of cases and fatalities due to this COVID-19, countries in Africa have the smallest number so far and population growth in terms of size tends to determine the standard of living in an economy. According to [7] who adjusted a growth model and shows that the second phase of the demographic transition is always associated with high economic and population growth due to lower death rate because of improved health care and regular supply of foods while the first phase leads to a net growth between the two.

2.2. Empirical Review

Post-COVID-19 efforts should provide Africa with much needed support to enhance financial innovation and access [7]. More specifically, there is need to scale the World Bank's programs which places women at the center of digital payment programs and leveraging digital technologies to improve trade, resources management, government and national payment systems that are secure, affordable, and accessible, all within a financial inclusion and stability program [9]. Digital payments are significantly safer than cash increasingly unlocking business growth and inclusion, despite the rigorous regulations to minimize the impact of COVID-19.

Several studies have been carried out to investigate the relationship existing between population growth and economic growth in Africa and previous studies that have discovered positive relationship between population growth and economic growth include that of [10-12]. The work of [10] empirically determine the impact of population growth on economic growth in Sub Saharan Africa from 1980 to 2015 using generalized method of moment (GMM) on panel data. The study findings summarized that population growth impacts economic growth positively and recommended that countries in these African countries should be proactive to take pragmatic measures that will improve the productivity of their population growth. Also, [11] employed an annual series data from 1981 to 2014, using the Cobb-Douglass production model to investigate the impact of population growth on economic growth as well. The findings showed a positive relationship between the two variables in Nigeria but underlined the fact that this is only made possible by population growth quality and not the entire population. These findings are similar the work of [12] that equally found population growth to be beneficial to economic growth in Nigeria using co-integration and Granger causality tests. It is important to note that an enabling or conducive environment where investment thrives and job creation grows will directly annexed the impact of population growth [13, 14].

Considering the pessimist view, [14] in his study on the implication of population growth on economic growth in African countries discovered that a negative relationship exists between the parameters of population growth used for the study (net migration, death rate and birth rate) and economic growth. Another related study by [16] on the effects food production, biodiversity protection and population growth on economic growth in Sub-Saharan African countries also revealed a negative influence between population growth and economic growth in these countries. The study equally revealed that population growth had severely and negatively affected biodiversity protection and food security. These research findings are similar to that of the pessimist view about population growth effects on economic growth. Over the years, countries in Africa have experienced tremendous rapid increase in population growth as a result of uncontrollable increase in their crude birth rate [17].

Theoretically, three factors are responsible for increasing population growth which are increasing birth rate, decreasing death rate and increasing net migration [18]. When increase in birth rate is solely responsible for rapid population increase, the population will be filled with a larger percentage of youth and young ones that are actively conformed and ready to work thereby contributing to economic growth. However, if decrease in death rate is responsible for population growth, the population will be filled with a higher percentage of old people that probably have lesser power to work and make tangible contributions to economic growth [18]. The effect of net-migration is practically negligible because most Africa countries citizens prefer to migrate to other developed continents where sources of livelihood and employment rates are better [20]. Unarguably, the level of unemployment, insecurity and corruption continue to increase in most African countries which are mostly factors that work against the economic growth of most countries in Sub Saharan African countries [21].

3. Methodology

3.1. The Model

Consider the multiple linear regression model for individual *i=1, 2..., N,*

Which is observed at over a period period *t= i, 2, 3..., T*

$$\alpha + \beta X_{it} + \gamma Z_i + C_t + U_{it} \quad (1)$$

Y_{it}= dependent variable α α = intercept,

Z_i = an M dimensional row vector of time-invariant explanatory variables,

C_i = an individual specific effect,

β = a K dimensional column vector of parameters,

U_{it} = Panel error term.

Where i is observed in all time t, this is called balanced panel. The T observation for an individual i can be summarized as

$$y_{it} = \begin{bmatrix} y_{i1} \\ \vdots \\ y_{it} \\ \vdots \\ y_{iT} \end{bmatrix} X_i = \begin{bmatrix} X'_{i1} \\ \vdots \\ X'_{it} \\ \vdots \\ X'_{iT} \end{bmatrix} Z_i = \begin{bmatrix} Z'_{i1} \\ \vdots \\ Z'_{it} \\ \vdots \\ Z'_{it} \end{bmatrix} U_i = \begin{bmatrix} U_{i1} \\ \vdots \\ U_{it} \\ \vdots \\ U_{iT} \end{bmatrix}$$

3.2. Panel Unit Root Test

Here we try to briefly explain Levin and Lin test: In unit root test for time series analysis, we considered stationary and non-stationary by an equation. Levin and Lin (LL) show that using unit root test in panel data for multiplication data have more power than using unit root test separately for each cross section.

Levin and Lin (1992) presented the unit root test as below:

$$\Delta y_{i,t} = \rho_i y_{i,t} + \delta_t + a_i + \epsilon_{i,t} \quad (2)$$

Where i= the number of cross sections,

t = time duration,

ρ_i = Parameter for each cross section

δ = the effect of t

a_i = the fixed coefficient for each cross section

$\epsilon_{i,t}$ = model error

That the model has a normal distribution with zero average and σ^2 variation. This test in base of ADF test would

$$H_{0:}\ \rho_1 = 0 \text{ vs } H_{1:}\ \rho_1 < 0.$$

According to Levin and Lin test (LL), we use equation 4 against normal equation to have

$$\Delta y_{i,t} = \rho_i y_{i,t-1+a_t} + \sum_{j=1}^{L} \theta_{ij} y_{i,t-j} + \epsilon_{i,t} \quad (3)$$

$$\Delta y_{i,t} = \sum_{j=1}^{L} \theta_{ij} y_{i,t-j} + \delta_{it} + a_t + \epsilon_{i,t \to \hat{\epsilon}_{i,t}} \quad (4)$$

with the quantity of these parameters, the test can be done.

3.3. PMG/Autoregressive Distributed Lag Model Test

An ARDL (Autoregressive-distributed lag) is a parsimonious infinite lag distributed model. The term "autoregressive" shows that along with getting explained by x_t, y_t also gets explained by its own lag also. Equation of ARDL (m, n) is as follows:

$$y_{it} = \beta_0 + y_{t-1} + \dots + \beta_p y_{t-m} + \alpha_0 X_t + \alpha_1 X_{t-1} + \dots + \alpha_q X_{t-n} + U_{it} \quad (5)$$

Where m, and n are the number of years for lag, β's is the coefficient of short-run relationship α's are the coefficients of long-run relationship.

U_{it} is the error term.

There is always collinearity which remains an issue when considering any econometrics model. The finite distributed lag model solves collinearity issue by selecting a suitable optimal lag length. The collinearity is being removed by the known polynomial distributed lag (PDL) by ensuring lag weights stay on their curves. But, for infinite lag model, there exist numerous parameters to estimate which makes them very complex to solve. These issues are been solved by determining a suitable lag length that goes for the model efficiently. While, on the contrary, it directly imposes a structure that makes the model non-linear. It is also known that the Geometric model works as an infinite lag distributed model but the ARDL model simply helps to address all these collinearity issues by allowing the lag of the dependent variable in the model with other independent variables and their lags.

4. Discussion of Result

Table 1. *Exploratory Data Analysis.*

Variables	GDP/Capita	Birth rate	Death rate	Net Migration
Mean	1.292995	37.85192	11.94319	-10656.45
Median	1.656471	39.60700	11.26850	-9824.825
Standard Deviation	6.557239	8.846273	4.604718	4.888962
Skewness	2.38897	-0.625782	0.667653	1.195548
kurtosis	63.30180	2.683584	3.327747	6.930298

Source: Researchers' computation using E-views and data from WDI.

The above table shows the summary of all the variables used with GDP per capital having an average mean of 1.292995, the birth rate with a mean of 37.85192, death rate with a mean of 11.94319 and net migration has a mean of -10656.45. Their standard deviation was obtained to be GDP per capita (6.557239), birth rate (8.846273), death rate (4.604718) and net migration has a standard deviation of 4.88962.

4.1. Panel Unit Root Test

Also, we consider the Lm, Pesaran and Shin W-stat to check if the variables are integrated at the same order with the first test.

Table 2. *The Levin, Lin, and Chu Test.*

Variables	T. Stat	Prob	T. Stat	Prob	Order
GDP/Capita	-5.2228	0.0000	-15.675	0.0000	I (0)
Birth Rate	-1.4219	0.0775	-21.150	0.0000	I (1)
Death Rate	-22.243	0.000	-27.037	0.0000	I (0)
Net Migration	-1.3538	0.0879	-15.759	0.0000	I (1)

Source: Researchers' computation using E-views and data from WDI.

Table 3. *The Lm, Pesaran and Shin W-stat.*

Variables	T. Stat	Prob	T. Stat	Prob	Order
GDP /Capital	-7.3021	0.0000	-21.983	.0000	I (0)
Birth Rate	-6.0698	1.0000	-19.582	0.0000	I (1)
Death Rate	-19.938	0.000	-23.497	0.0000	I (0)
Net Migration	-2.6976	0.0531	-13.183	0.0000	I (1)

Source: Researchers' computation using E-views and data from WDI.

The above table shows the panel unit root test been carried out for this work. The Levin, Lin, and Chu test and Lm, Pesaran and Shin W-stat were used to determine the stationarity conditions of the variables, from the above all the variables (GDP/capita and death rate) are all stationary at first level while birth rate and net migration are stationary at first difference level.

If series are integrated of different orders. That is a combination of both level and first difference stationarity. Performing a co-integration test is necessary to establish the long run relationship among the variables but since the variables are integrated of different orders, the use of the Johansen co-integration test is no longer valid, we therefore proceeded to Pooled Mean Group/ Autoregressive Distributed Lag model (PMG/ARDL) proposed by ([21, 22]) to show the relationship between the variables.

H_0: There is no relationship between the variables.

H_1: There is a relationship among the variables.

4.2. Pooled Mean Group Autoregressive Distributed Lag (PMG/ARDL Test)

Table 4. *Long Run Relationship.*

Variables	Coefficient	Standard Error	T. Stat	Prob
Birth Rate	-0.468134	0.071308	-6.564965	0.0000
Death Rate	0.199567	0.108993	1.830999	0.0676
Net Migration	-0.00000486	0.0000044	-1.105374	0.2695

Source: Researchers' computation using E-views and data from WDI.

Table 5. *Short Run Relationship.*

Variables	Coefficient	Standard Error	T. Stat	Prob
COINTEQ01	-0.957711	0.067683	-14.15944	0.0000
Birth Rate	1.787125	2.382189	-0.750203	0.4534
Death Rate	-6.813535	2.426031	-2.808512	0.0051
Net Migration	-0.0012	0.0036	-0.351952	0.00725
C	14.48872	1.472410	9.840139	0.0000

Source: Researchers' computation using E-views and data from WDI.

The above tables show the PMG/ARDL long run and the short-run relationship among the variables. From the table, it shows there exist a long run relationship between birth rate and GDP/capital while death rate and net migration do not have any long-run relationship with the dependent variable (GDP/Capita) since there probability values are above the 5% level of significance. On the other hand, the short run relationship shows there exist a short run relationship among the variables with the probability value of COINEQ01 below the 5% significance level. Also, there exist short-run relationships (death rate and GDP/capita) and (net migration and GDP/capita) with their probability values less than 5 %, and the constant also contributes significantly to the short run relationship among the variables.

Granger Causality Test

In determining the direction of relationships that exist between the variables, the Granger Causality test was used as suggested by Engle and Granger to show the bidirectional causal relationship between the variable since there exist a long run relationship between GDP per capital and birth rate and short-run relationship GDP per capital with death rate and net migration.

Table 6. *Granger Causality Test.*

Directions	F-Statistic	Prob	Decision
BR to GDP/Capita	0.38825	0.5334	Do not reject H_0
GDP/capita to BR	9.01180	0.0135	Reject H_0
DR to GDP/capita	2.33199	0.1272	Do not rejectH_0
GDP/capita to DR	10.7083	0.0011	RejectH_0
NM to GDP/capita	1.05951	0.3037	Do not rejectH_0
GDP/capita to NM	31.6463	0.00003	RejectH_0

Source: Researchers' computation using E-views and data.

The result has shown that birth rate has no cause unto GDP per capital but there is causality from GDP per capital to birth rate. This shows a unidirectional causality, and it holds true that higher EG is one of the major factors causing a higher birth rate in developing countries.

Also, the result shows that the death rate has no cause unto GDP per capital but there is causality running from GDP per capital to death rate indicating a unidirectional causality. This means that the higher EG and increase in income per head among the citizens do not automatically bring about fall in death rate rather it aggravates it. This phenomenon in developing African countries could be because of resources not evenly spread and allocation of increasing income realized from the growth in the provision of health and health care facilities.

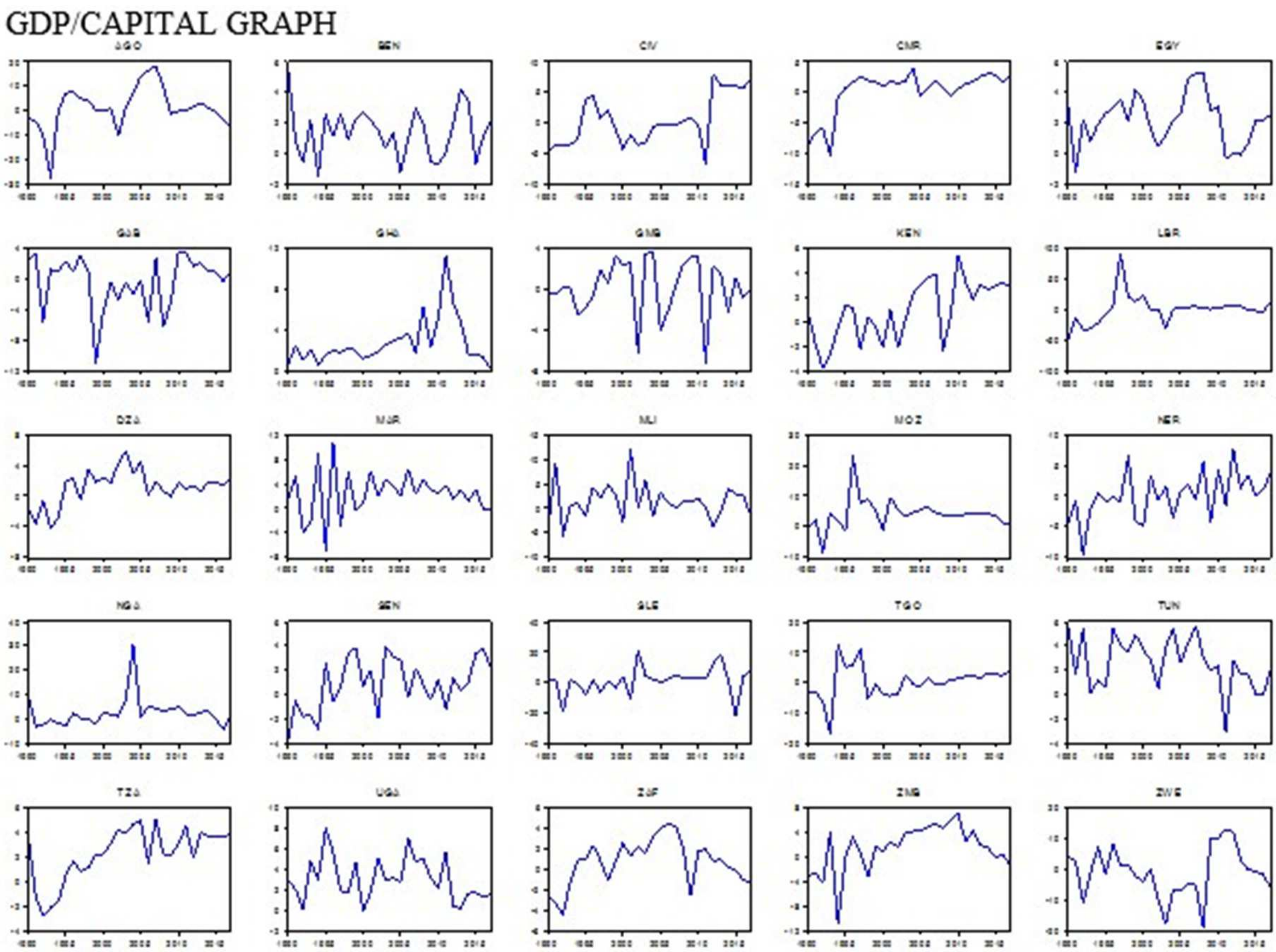
Also, the result shows that there is a unidirectional relationship between GDP per capital to net migration which indicates a unidirectional causality.

5. Conclusion

Many researchers had used time series econometrics tools in explaining the time phases of the consequences of the rate of PG with respect to birth rate, death rate and net migration on the gross domestic product per capita growth of most developing countries. However, this research work as stated earlier has proffered to panel data econometric analysis to take into consideration both the time as well as the size or space dimensions of these consequences. The main objective of this study is to estimate by using an econometric model of panel data analysis from a sample of twenty-five developing countries for the period of twenty-seven years to empirically analyze the relationship that exists between PG and EG both on the short run and on the the-long run. As seen from the pooled mean group autoregressive lag model, that only birth rate had a long run relationship between GDP per capita with a test statistic of (-6.564965) and a probability value less than 0.05 while there are short-run relationships between the dependent variable (GDP per capital) and other explanatory variables (death rate and net migration) with test statistic (-2.80851,-0.3519). Also, the Granger causality test showed a unidirectional causality among the variables, there is causality from GDP per capital to birth rate, death rate and net migration with F. statistic of (9.01180, 10.7083, 31.6463) and probability values less than 0.05 of (0.0135, 0.0011, 0.00003).

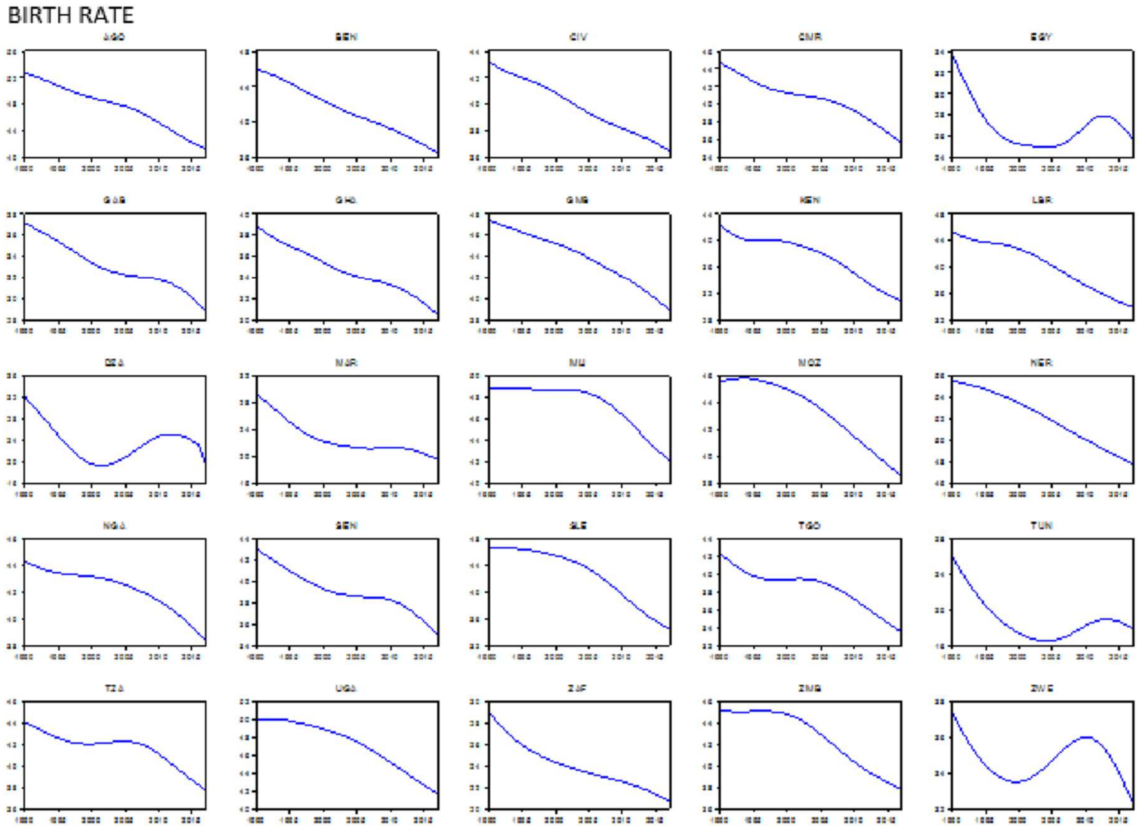
It is evident that there exists long-run relationship between GDP/capita and birth rate which explains that as the economy becomes viable and there is flow of cash in circulation, people tend to increase the number of children they have in these developing countries while a short run relationship exists between GDP/capital and the other two explanatory variables. More strategically, Africa's population dynamics and its poise for post-COVID-19 socio-economic recovery should deploy digital technologies as innovative pathways for opening the doorways of inclusive development, thereby serving as effective tools for bringing African businesses back better as well as deploying the African Continental Free Trade Area (AfCFTA) in better management of its population, market and business growth [22, 23].

Appendix



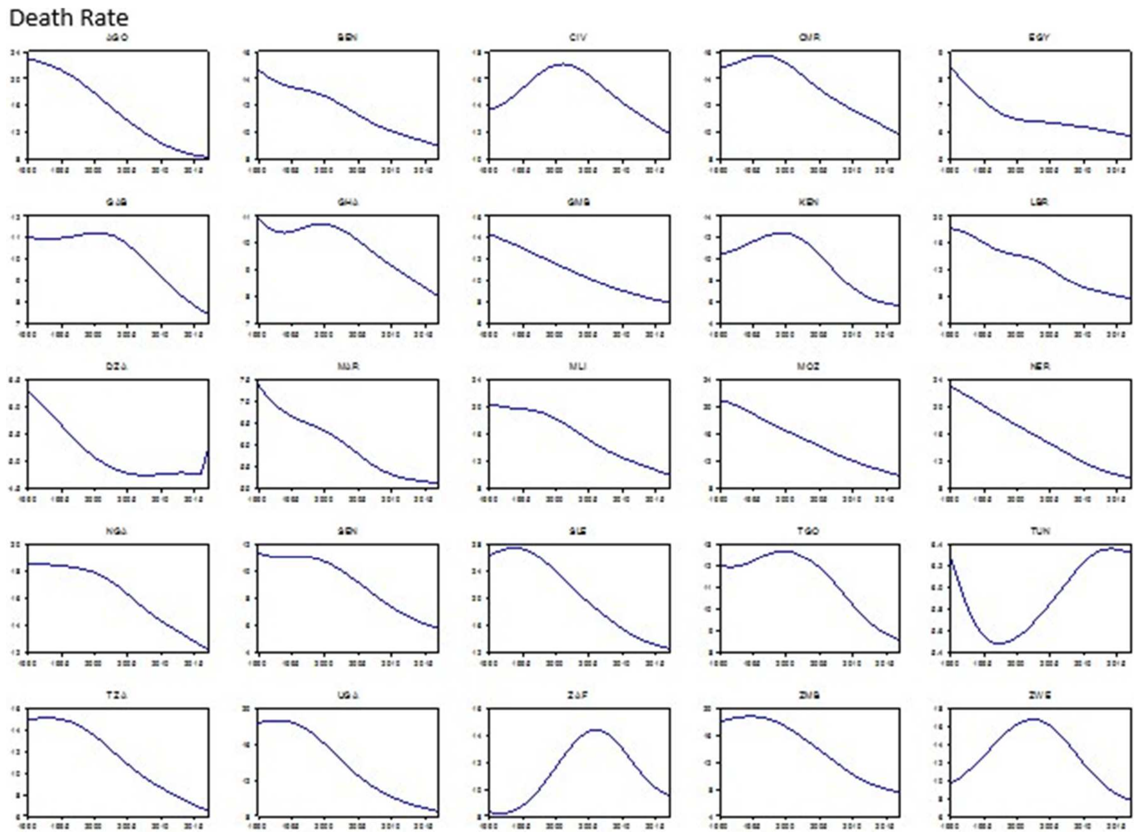
Source: Researchers' computation using Eviews and data from WDI

Figure 1. *GDP/Capita Time plot.*



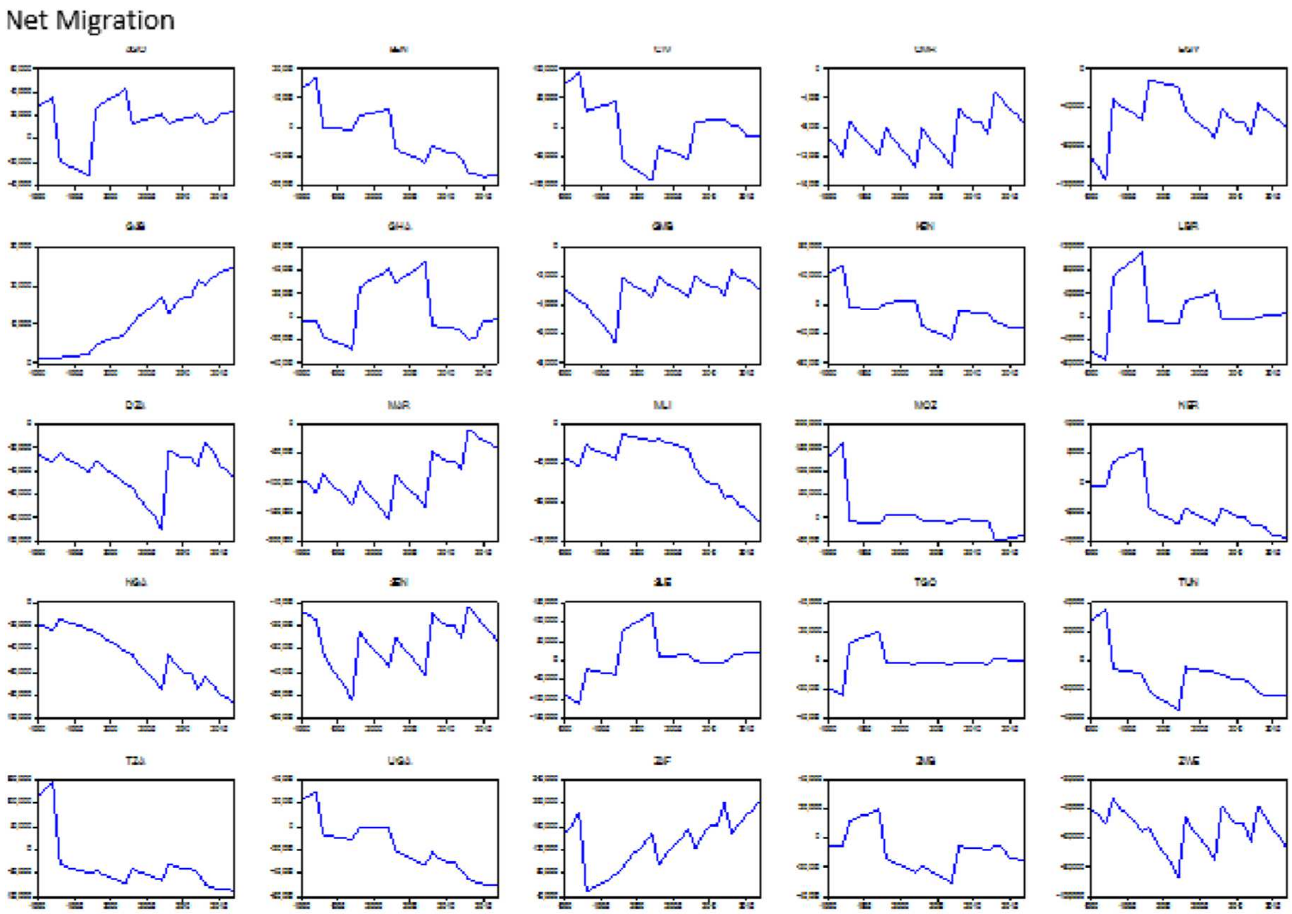
Source: Researchers' computation using EViews and data from WDI

Figure 2. *Birth Rate Time plot.*



Source: Researchers' computation using EViews and data from WDI

Figure 3. *Death Rate Time plot.*



Source: Researchers' computation using EViews and data from WDI

Figure 4. *Net Migration Time plot.*

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